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On a closer examination it turned out that they were acute rhombohedrons with four planes largely and the other two planes only very minutely developed, thus giving to the crystal the appearance of a tetrahedron or sphenoid, two of whose angles were truncated by small planes.

It suggested itself as a means of obtaining crystals from a saturated carbonic acid solution of those substances not readily soluble in pure water, to allow the gas to escape uniformly but slowly, and thus allow each crystal time to complete its complement of planes.

April 30.

The President, Dr. Ruschenberger, in the chair.

Twenty-nine members present.

The death of Wm. W. Gerhard, M.D., was announced.

The following were elected members: Geo. Stiles, M.D., Passmore Williamson, Bloomfield H. Moore, Mrs. Bloomfield H. Moore, Alfred D. Jessup, Wm. F. Miskey, Wm. G. Freedly, F. B. Gowen, E. Burd Grubb, Thos. R. Dunglison, M.D., and John Thompson.

Permission being granted, Dr. H. Allen called attention to a novel method of studying the appendicular skeleton of vertebrates. He had found that a radiated arrangement of bones could be detected in the shoulder girdle. The recognition of such a plan suggested the propriety of characterizing rays as divergent from a hypothetized centre with respect to their positions to the longitudinal axis of the body. The scapula thus becomes the *neurad;* the pre-coracoid and coracoid bones the *heamad;* while the ray of the arm is the *manad.* The neurad ray is single and may segment twice, as in some batrachians, or but once, as in others of the same class. The heamad rays never segment. They may be single or double. The manad rays are multiple in fishes, and may not diverge from a single point. In *Gobius* some of these rays appear as actinapophyses to the neurad rays.

The manad rays are single in other vertebrates. They do not segment in fishes, but may twice segment ("glenoid"-brachium) with other forms. It is necessary to remember that the centre of this radiate arrangement is not at all times at the shoulder-joint, but may be at a point at which the "glenoid" (Parker) scapular, pre-coracoid, and coracoid bones converge. This is instanced in man and the salamander.

The study of the pelvic girdle yields similar results to those above stated. The centre here is at the acetabulum. The neurad ray (ilium), the two heamads (pubis and ischium), as well as the pesad (femur) do not segment. The late Y-shaped ossification (man) is without morphological value.

Dr. A. endeavored to establish a plan for the construction of the hand and foot, by premising a system of divergent rays projecting from the distal extremity of the manad and pedad segments respectively. He conceived it to present a better principle of action than does the hypothesis of Gegenbaur, which rests upon marginal chains of ossicles appended distad to the limb.

In the fish the primal divergence of the rays from the multiple manad are infinite, and do not permit of subsequent divergences. In all other vertebrates the primal divergence is finite (single), and the subsequent divergences vary; they attain their maximum number (four) in the carpus and tarsus of *Ichthyosaurus* and *Plesiosaurus.*

In taking the limbs of the salamander[1] as illustrations, it is found that the humerus gives off at the elbow two rays, the ulna and radius. The ulna at the wrist gives off two rays in the shape of carpal bones, which are serially homologous with the radius and ulna. The lateral (*i. e.* outer) ray segments three times to produce the outer toe. The median (*i. e.* inner) ray segments once and then yields divergents to produce by serial segmentation the toes placed median to the axis of the carpal quantity. The radius does not present divergents but segments to project the innermost toe. In this arrangement the ulna is seen to be the more potential of the divergents of the humerus, since its several divergences make up the bulk of the hand and account for the projection of all the toes excepting the innermost. In the foot the fibula is the more potential bone, since the area of its related divergences yields the bulk of the foot, as does the ulna in the hand. Again, of the first ulnar divergence the median is the more potential, since the lateral passes off to the outer toe, exhibiting axial repetition of segments only. The tendency for the greater potentiality to be found in the median ray of any given divergence, finds an apparent exception in the penultimate divergence in *Ichthyosaurus* and *Plesiosaurus*, where it would appear as though the lateral ray yielding the last divergence is the *outer* instead of the *inner* side. Enough is secured, however, to modify the prevalent idea concerning the acquisition of toes. Conceding that the above scheme is correct, it will follow, that, inasmuch as in the several divergences the median rays are favored, and the toes are the ultimate projections of such rays, they may be initiated from towards the centre and not always from the sides. It was observed, for example, that in the bi-dactylous foot of the *Proteus* the ulnar divergent produced an axis composed of five segments to constitute the outer toe. The radial divergent repeated segments four times, the terminal three comprising the inner toe. Now, the hand of the *Proteus* is *tri*-dactylous, and it is found that the third toe is the median ray of a divergence terminating the *ulnar* projection.

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[1] Gegenbaur.

In this connection reference was made to Buhl's[1] account of a case of congenital defect in the human foot, in which four toes only were present. The missing toe was the fourth, which is the *median* terminal divergent of calcaneal side of foot; the normal arrangement of the human foot being as follows: The potential side (tibial (?), remembering the twist of the posterior extremity, caused the speaker to consider the potential side of the foot to be homologous with the ulnar side of the hand) is segmented twice (astragalus and scaphoid) to produce three divergents (1st, 2d, and 3d metatarsals), each of which segments four times in forming the first three toes. The outer weaker side segments serially twice (calcaneum, cuboid) to yield two divergents (4th and 5th metatarsals), which thence form the fourth and fifth toes.[2]

The relations between the term actinapophysis and the term ray, as used in the above descriptions, were next dwelt upon. It was proposed to restrict the term actinapophysis to a segment projected from the *side* of an axial ray, while such axial rays are always in themselves projections from a hypothetical non-osseous centre. It follows that unless a ray can be traced to such centre, it cannot be considered of primal value, and becomes actinapophysal. In the event of the correctness of this hypothesis, many of the identifications of Parker must fall.

Actinapophyses may behave like primal rays with respect to the bone from which they spring. The separately ossified tip to the acromion process is an example. This is an interesting expression of an actinapophysis projecting in an opposite direction to the axis of its own ray. Ruge,[3] in his descriptions of abnormalities of the acromion, figures two disjuncted actinapophyses in the above position. They are, it was judged, the two centres of ossification of the acromial tip, not co-ossified axially, as is the rule, but placed as divergents to the primal ray.

Dr. A. felt inclined to claim for such centres the name of "centres of nutrition," and to revert the present application of the theory to Goodsir[4] (1845).

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[1] Congenital absence of femur, etc. Zeit. f. Rat. Med., 1860, p. 128.

[2] In the hand the radius (ulna, Gegenbaur) yields the scaphoid for a segment, and the trapezius and trapezium as divergents (probably). The ulna gives the semilunar for a segment and magnum unciform and cuneiform for divergents; the fourth and fifth toe are secondary divergences from the unciform (probably).

[3] Zeit. f. Rat. Med., 1859, p. 258.

[4] "Of the forces which exist in connection with centres of nutrition nothing very definite can yet be stated. When this branch of inquiry shall have been opened up, we shall expect to have a science of organic forces bearing direct relations to anatomy, the science of organic forms."—*An. and Path. Obs.*, Art. Centres of Nutrition.

The speaker was of the opinion that, as a principle, it was capable of interpreting much of the skeleton. He had reason to believe, that, the bilaterality of centres of ossification (Serres) so far as they apply to the neural and heamal axes (vertebral column and sternum) being assumed, all other arrangements of the scleral tissues were about " centres of nutrition." The costal series (inclusive of the clavicles), with its multiple segmentations and occasional actinapophyses; and more especially the infra-cranial arches (the branchial (hyoid), mandibular apparatuses), were held to be parts of a system similar to the above in kind.

On favorable report of the Committees, the following papers were ordered to be printed:—